

Claims

What is claimed is:

1. A method of responding to an under frequency event in an electrical delivery system that provides power to an electrical appliance, the method comprising the steps of:

measuring a time period of each power line cycle of a power source;

comparing the measured time period to a trigger period,

if a cycle time period is greater than or equal to the trigger period, an under frequency counter is incremented,

if the cycle time period is less than the trigger period, the under frequency counter is decremented;

detecting an under frequency condition and initializing the line under frequency (LUF) response when the counter is incremented to a counter trigger level; and

initializing a restore response after the frequency rises above a restore value that triggers the under frequency counter to count down until it reaches zero, thereafter indicating that the under frequency event has ceased.

2. The method of claim 1, after the step of detecting an under frequency condition further comprising the step of measuring the time period of the power line cycle while in a state of under frequency;

comparing the measured time period of the under frequency line to a restore period,

if the under frequency cycle time period is greater than or equal to the restore period, the counter is incremented,

if the under frequency cycle time period is less than the restore period, the counter is decremented.

3. The method of claim 2, further comprising the step of incrementing the under frequency counter if the under frequency counter is less than the counter trigger level.

4. The method of claim 1, wherein initializing the LUF response comprises the step of controlling the load.

5. The method of claims 1, wherein initializing the LUF response comprises the step of temporarily disconnecting the load from the power source.

6. The method of claim 1, wherein the restore response comprises the step of restoring all loads powered by the electrical delivery system.

7. The method of claim 1, wherein initializing a restore response further comprises initiating an out response when the under frequency counter reaches zero.

8. A system for responding to an under frequency event in an electrical delivery system that provides power to an electrical appliance, the system comprising:

means for measuring a time period of each power line cycle of a power source;

means for comparing the measured time period to a trigger period,

if a cycle time period is greater than or equal to the trigger period, an under frequency counter is incremented,

if the cycle time period is less than the trigger period, the under frequency counter is decremented;

means for detecting an under frequency condition and initializing the line under frequency (LUF) response when the counter is incremented to a counter trigger level; and

means for initializing a restore response after the frequency rises above a restore value that triggers the under frequency counter to count down until it reaches zero, thereafter indicating that the under frequency event has ceased.

9. The system of claim 8, wherein time measuring means is also adapted to measure the under frequency power line and comparing means is also adapted to compare the measured time period and with a restore period to determine if the power line is out of an under frequency state.

10. The system of claim 8, wherein means for initializing the LUF response is adapted to control the load or temporarily disconnect the load from the power source when the counter is incremented to the counter trigger level.

11. The system of claim 8, wherein mean for initializing the restore response is adapted to initiate an out response when the under frequency counter reaches zero.
12. An under frequency protection thermostat-type device comprising:
  - a thermostat-type housing;
  - a transformer adapted to be electrically connected to a primary voltage source having a predefined frequency level and disposed within said housing;
  - a line under frequency (LUF) detection and measurement module electrically connected to the transformer and adapted to detect a line under frequency condition from a signal received from the transformer;
  - a microcontroller connected to the LUF detection and measurement module and adapted to send a command to disengage and engage an electrical load as a function of a measured frequency of the voltage source over a predefined period of time, wherein the measured frequency is compared to a predefined frequency threshold; and
  - a load switch connected to the microcontroller adapted to respond to a command from the microcontroller to disengage and engage an electrical load from the voltage source.
13. An under frequency protection thermostat-type device comprising:
  - a thermostat-type housing;

a line under frequency (LUF) detection and measurement module electrically connected to the transformer and adapted to detect a line under frequency condition from a signal received from the transformer;

a microcontroller connected to the LUF detection and measurement module and adapted to send a command to disengage and engage an electrical load as a function of a measured frequency of the voltage source over a predefined period of time, wherein the measured frequency is compared to a predefined frequency threshold.

14. The device according to claim 13, further comprising a transformer adapted to be electrically connected to a primary voltage source having a predefined frequency level and disposed within said housing and a load connected to the microcontroller adapted to respond to a command from the microcontroller to disengage and engage an electrical load from the voltage source.

15. The device of claim 13, wherein the LUF detection module is adapted to determine the line frequency status of each power line cycle by counting ticks on an interval timer between two successive zero-crossing falling edges of the power line, thereby generating the measured frequency of the voltage source.

16. The device of claim 15, wherein the microcontroller sends a command to disengage the load when the measured frequency over the predefined period of time is below the frequency

threshold and sends a command to engage the load when the measured frequency is above the frequency threshold.

17. A line under frequency detection system comprising;

a microcontroller adapted to send a command to disengage and engage an electrical load as a function of a measured frequency of a voltage source over a predefined time period, wherein the measured frequency is compared to a predefined frequency threshold;

a level shift and limit module connected to the microcontroller and to the voltage source;

a first memory arrangement adapted to provide a trigger period and a restore period and connected to a comparator module within the microcontroller;

a crystal oscillator connected to the comparator module, wherein the comparator module is adapted to compare the time period to the trigger period for decreasing measured frequency and to a restore period for an increasing measured frequency; and

a second memory arrangement adapted to provide an under frequency count value to an under frequency counter within the microcontroller.

18. The detection system of claim 17, further comprising an interrupt module adapted to measure the time period of the measured frequency sourced from the level shift and limit module.

19. The detection system of claim 17, further comprising an implement control response module connected to the under frequency counter.
20. The detection system of claim 19, further comprising an under and over frequency top within the microcontroller and an LUF status tap between the under frequency counter and the implement control response module.